PATENT COOPERATION TREATY

From the
INTERNATIONAL SEARCHING AUTHORITY

To:

see form PCT/ISA/220

WRITTEN OPINION OF THE INTERNATIONAL SEARCHING AUTHORITY
(PCT Rule 43*bis*.1)

Date of mailing *(day/month/year)* see form PCT/ISA/210 (second sheet)	
Applicant's or agent's file reference see form PCT/ISA/220	**FOR FURTHER ACTION** See paragraph 2 below

International application No.	International filing date *(day/month/year)*	Priority date *(day/month/year)*
PCT/IB2005/050040	05.01.2005	13.01.2004

International Patent Classification (IPC) or both national classification and IPC
H01J35/16

Applicant
KONINKLIJKE PHILIPS ELECTRONICS, N.V.

1. This opinion contains indications relating to the following items:

- ☒ Box No. I Basis of the opinion
- ☐ Box No. II Priority
- ☐ Box No. III Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
- ☐ Box No. IV Lack of unity of invention
- ☒ Box No. V Reasoned statement under Rule 43*bis*.1(a)(i) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement
- ☐ Box No. VI Certain documents cited
- ☒ Box No. VII Certain defects in the international application
- ☒ Box No. VIII Certain observations on the international application

2. **FURTHER ACTION**

If a demand for international preliminary examination is made, this opinion will usually be considered to be a written opinion of the International Preliminary Examining Authority ("IPEA"). However, this does not apply where the applicant chooses an Authority other than this one to be the IPEA and the chosen IPEA has notifed the International Bureau under Rule 66.1*bis*(b) that written opinions of this International Searching Authority will not be so considered.

If this opinion is, as provided above, considered to be a written opinion of the IPEA, the applicant is invited to submit to the IPEA a written reply together, where appropriate, with amendments, before the expiration of three months from the date of mailing of Form PCT/ISA/220 or before the expiration of 22 months from the priority date, whichever expires later.

For further options, see Form PCT/ISA/220.

3. For further details, see notes to Form PCT/ISA/220.

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Authorized Officer

Krauss, J

Telephone No. +49 89 2399-2061

Box No. I Basis of the opinion

1. With regard to the **language**, this opinion has been established on the basis of the international application in the language in which it was filed, unless otherwise indicated under this item.

   ☐ This opinion has been established on the basis of a translation from the original language into the following language , which is the language of a translation furnished for the purposes of international search (under Rules 12.3 and 23.1(b)).

2. With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application and necessary to the claimed invention, this opinion has been established on the basis of:

   a. type of material:

   ☐ a sequence listing

   ☐ table(s) related to the sequence listing

   b. format of material:

   ☐ in written format

   ☐ in computer readable form

   c. time of filing/furnishing:

   ☐ contained in the international application as filed.

   ☐ filed together with the international application in computer readable form.

   ☐ furnished subsequently to this Authority for the purposes of search.

3. ☐ In addition, in the case that more than one version or copy of a sequence listing and/or table relating thereto has been filed or furnished, the required statements that the information in the subsequent or additional copies is identical to that in the application as filed or does not go beyond the application as filed, as appropriate, were furnished.

4. Additional comments:

Box No. V Reasoned statement under Rule 43*bis*.1(a)(i) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Statement

Novelty (N)	Yes:	Claims	
	No:	Claims	1-21
Inventive step (IS)	Yes:	Claims	
	No:	Claims	1-21
Industrial applicability (IA)	Yes:	Claims	1-21
	No:	Claims	

2. Citations and explanations

see separate sheet

Box No. VII Certain defects in the international application

The following defects in the form or contents of the international application have been noted:

see separate sheet

Box No. VIII Certain observations on the international application

The following observations on the clarity of the claims, description, and drawings or on the question whether the claims are fully supported by the description, are made:

see separate sheet

Re Item V

Reasoned statement with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

Reference is made to the following documents:

D1: US-A-6 151 384 (REED ET AL), 21 November 2000
D2: US-B1-6 490 340 (ARTIG CHRISTOPHER F ET AL), 3 December 2002
D3: GOODFELLOW CORPORATION: "Goodfellow CD-ROM Catalogue 2001/2002", 1 September 2001, GOODFELLOW CORPORATION, BERWYN, XP002336226

Remark:
The terms "high" and "lower" in claim 1 have no well-recognised meaning (cf. item VIII below). With regard to the description, for the following analysis, the wording of claim 1 is understood as related to two materials, whereby the first / second material has a higher / lower thermal conductivity and lower / higher deformation resistance than the other, respectively.

V1 The present application does not meet the criteria of Article 33(1) PCT, because the subject-matter of present **independent claims 1, 18 and 20** is **not new** in the sense of Article 33(2) PCT.

V1.1 The document **D1** discloses the subject matter of present claim 1 (the references in parentheses applying to this document):

An x-ray tube (title)
comprising:
a frame (envelope E2, figure 2, column 2, ll. 39-40)
which encloses an evacuated chamber (column 2, ll. 39-40);
an anode (anode A2, figure 2; column 2, ll. 42-44)
disposed within the evacuated chamber (figure 2, column 2, ll. 42-44);
the frame including a vessel (envelope E2)
which surrounds the anode (figure 2, column 2, ll. 42-44),

the vessel being defined by a combination of a material with high thermal conductivity and lower deformation resistance (front face I of the vacuum envelope made of titanium; figure 4b, column 9, ll. 1-3)
and a material with high deformation resistance and lower thermal conductivity (rigid ribs K made of stainless steel; figure 4b column 9, ll. 3-8).

D1 further discloses the subject matter of present **claim 18**:

A method of transferring heat from an x-ray tube to a surrounding cooling fluid (column 7, ll. 9-13)
comprising;
conducting heat from an evacuated chamber (evacuated interior volume V2, column 2, l. 40)
through a liner of the x—ray tube formed from a thermally conductive material (front face of vacuum envelope I, column 9, ll. 1-3);
restraining the liner against deformation with a structural framework (rigid ribs K, column 9, ll. 3-8).

V1.2 D1 further discloses the subject matter of present **claim 20**:

An x-ray tube (title)
comprising:
a thermally conductive liner (front face of vacuum envelope I, column 9, ll. 1-3)
which spaces an evacuated chamber of the x-ray tube from a surrounding cooling fluid (figures 2, 4b);
a structural framework forming a cage which reinforces the liner against deformation (rigid ribs K, column 9, ll. 3-8).

V1.3 The subject-matter of present claim 1 is further not new in the sense of Article 33(2) PCT over the disclosure of D2.

The document **D2** discloses (the references in parentheses applying to this document):

An x-ray tube (title)
comprising:
a frame (vacuum enclosure 10 and shroud 35, figure 2, column 4, ll. 11-24)
which encloses an evacuated chamber (figure 2, column 4, ll. 11-24);
an anode (anode rotating anode assembly 12, figures 1 and 2; column 1, ll. 31-33, column 4, ll. 11-24)
disposed within the evacuated chamber (figure 2);
the frame including a vessel (vacuum enclosure 10)
which surrounds the anode (figure 2),
the vessel being defined by a combination of a material with high thermal conductivity and lower deformation resistance (vacuum enclosure 10 made of copper, column 4, ll. 25-27)
and a material with high deformation resistance and lower thermal conductivity (shroud 35 made of tungsten, column 4, ll. 29-31).

V2 The subject matter of present **dependent claims 2-17, 19, 21** is **also not new** with respect to the disclosure of D1 or D2:

claim 2:
An x-ray tube according to claim 1 (cf. items V1.1 and V1.3 above), wherein the vessel includes:
a liner formed from a thermally conductive material which at least partially defines the evacuated chamber (D1, front face I of the vacuum envelope made of titanium, figure 4b and column 9, ll. 1-3; D2, vacuum enclosure 10 made of copper, column 4, ll. 25-27);
and a framework which supports the liner and is formed from a structural material (D1, rigid ribs K made of stainless steel in figure 4b, column 9, ll. 3-8; D2, shroud 35 made of tungsten, column 4, ll. 29-31),
the framework defining at least one thermal window therein (D1, free standing foils I between each pair of ribs K, figure 4b; D2, figures 2 and 3, the space between the fins 34, column 4, ll. 20-23)
through which the liner is in thermal contact with both the evacuated chamber and a surrounding cooling fluid (D1, figures 2, 4b cooling fluid is air, column 7, ll. 9-13; D2, cooling fluid is again air, figures 2 and 3).

claim 3:
framework and liner concentric: D1, figure 4b; D2, figures 2,3

claim 4:
framework surrounds the liner: D2, figures 2, 3

claim 5:
thermal window comprises at least one slot: D1, the free standing foils I between each pair of ribs K in figure 4b form slots; D2, figures 2 and 3, the space between the fins 34 forms slots

claim 6:
angularly spaced slots: D2, figure 3

claims 7, 8:
the thermally conductive material has a thermal conductivity at least twice that of the structural material and the structural material has a yield strength which is at least twice that of the thermally conductive material: D2, copper has a thermal conductivity of 401W/mK and a yield strength of 54MPa, tungsten has a thermal conductivity of 173W/mK and a yield strength of 550MPa (cf. e.g. D3)

claim 9:
structural material includes stainless steel: D1, column 9, l. 8

claim 10:
thermally conductive material includes copper: D2, column 4, l. 27

claim 11:
liner includes a cylindrical side and a base and framework includes a cylindrical side and a base, the side of the liner being joined to the side of the framework: D2, figures 2, 3

claim 12:
one of the liner and the framework is received within the other: D1, figure 4b; D2,

figures 2, 3

claim 13:
the liner defines a central aperture and the framework defines a central aperture, the anode including a shaft which extends through the central apertures: D2, figures 1-3, column 3, ll. 28-37

claim 14:
the liner and the framework define a fluid flowpath there between for the cooling fluid to contact the liner: D2, figures 1-3, air flow through fins 34, column 4, ll. 41-47

claim 15:
plate which closes an end of the vessel, the plate defining an aperture through which a cathode assembly extends for emitting electrons that pass between a cathode and the anode: D2, protrusion 17 in figure 1

claim 16:
vessel comprises a laminate of the conductive and structural materials: D1, figure 4b

claim 17:
a housing surrounding at least a portion of the x-ray tube, the housing containing the cooling fluid: D2, figures 1-2, implicitly

claim 19:
the structural framework defines at least one thermal window, the heat flowing directly between the liner and the surrounding cooling fluid in the thermal window: cf. claim 2

claim 21:
anode mounted in the evacuated chamber: D1, figure 2

V3 **Remark:**
None of the available documents discloses an x-ray tube comprising a **combination of all the features of present claims 1, 2, 9 and 10** insofar as they can be

understood (cf. items VIII1 and VIII2 below).
Furthermore, a combination of D1 and D2 is not obvious to a skilled person but would be based on an ex-post-facto analysis.

Re Item VII
Certain defects in the international application

VII1 Independent claims 1, 18 and 20 are not drafted in the **two-part form** according to Rule 6.3 PCT.

VII2 **Reference sign (124)** in claims 2 and 19 refers not to thermal windows as indicated in the claims but to a cooling fluid outlet port (description, p. 13, l. 37)

Re Item VIII
Certain observations on the international application

VIII1 The **relative terms** "high" and "lower" used in **claim 1** have no well-recognised meaning and leave the reader in doubt as to the meaning of the technical features to which they refer, thereby rendering the definition of the subject-matter of said claim **unclear**, Article 6 PCT.
In particular, it is not clear from the wording of claim 1 whether the term "lower" with respect to deformation resistance / thermal conductivity of one material refers to the respective property of the other material (which would be a clear feature with respect to the term "lower" and the relation of the two materials) or just to a generally "lower" (thus "low") value of the respective property.

VIII2 The term **"deformation resistance"** in **claim 1 is unclear** as it does not relate to a particular, well-defined property of the material such as yield strength or the like.

VIII3 Although **claims 1 and 20** have been drafted as **separate independent apparatus claims**, they appear to relate effectively to the same subject-matter and to differ from each other only with regard to the definition of the subject-matter for which protection is sought and in respect of the terminology used for the features of that

subject-matter. The aforementioned claims therefore lack conciseness and as such do not meet the requirements of Article 6 PCT.

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International Patent Classification (IPC) or both national classification and IPC
H01J35/16

Applicant
KONINKLIJKE PHILIPS ELECTRONICS, N.V.

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- ☒ Box No. V Reasoned statement under Rule 43*bis*.1(a)(i) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement
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WRITTEN OPINION OF THE INTERNATIONAL SEARCHING AUTHORITY

International application No.
PCT/IB2005/050040

Box No. I Basis of the opinion

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2. With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application and necessary to the claimed invention, this opinion has been established on the basis of:

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4. Additional comments:

Box No. V Reasoned statement under Rule 43*bis*.1(a)(i) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Statement

Novelty (N)	Yes:	Claims	
	No:	Claims	1-21
Inventive step (IS)	Yes:	Claims	
	No:	Claims	1-21
Industrial applicability (IA)	Yes:	Claims	1-21
	No:	Claims	

2. Citations and explanations

see separate sheet

Box No. VII Certain defects in the international application

The following defects in the form or contents of the international application have been noted:

see separate sheet

Box No. VIII Certain observations on the international application

The following observations on the clarity of the claims, description, and drawings or on the question whether the claims are fully supported by the description, are made:

see separate sheet

Re Item V

Reasoned statement with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

Reference is made to the following documents:

D1: US-A-6 151 384 (REED ET AL), 21 November 2000
D2: US-B1-6 490 340 (ARTIG CHRISTOPHER F ET AL), 3 December 2002
D3: GOODFELLOW CORPORATION: "Goodfellow CD-ROM Catalogue 2001/2002", 1 September 2001, GOODFELLOW CORPORATION, BERWYN, XP002336226

Remark:
The terms "high" and "lower" in claim 1 have no well-recognised meaning (cf. item VIII below). With regard to the description, for the following analysis, the wording of claim 1 is understood as related to two materials, whereby the first / second material has a higher / lower thermal conductivity and lower / higher deformation resistance than the other, respectively.

V1 The present application does not meet the criteria of Article 33(1) PCT, because the subject-matter of present **independent claims 1, 18 and 20** is **not new** in the sense of Article 33(2) PCT.

V1.1 The document **D1** discloses the subject matter of present claim 1 (the references in parentheses applying to this document):

An x-ray tube (title)
comprising:
a frame (envelope E2, figure 2, column 2, ll. 39-40)
which encloses an evacuated chamber (column 2, ll. 39-40);
an anode (anode A2, figure 2; column 2, ll. 42-44)
disposed within the evacuated chamber (figure 2, column 2, ll. 42-44);
the frame including a vessel (envelope E2)
which surrounds the anode (figure 2, column 2, ll. 42-44),

the vessel being defined by a combination of a material with high thermal conductivity and lower deformation resistance (front face I of the vacuum envelope made of titanium; figure 4b, column 9, ll. 1-3)
and a material with high deformation resistance and lower thermal conductivity (rigid ribs K made of stainless steel; figure 4b column 9, ll. 3-8).

D1 further discloses the subject matter of present **claim 18**:

A method of transferring heat from an x-ray tube to a surrounding cooling fluid (column 7, ll. 9-13)
comprising;
conducting heat from an evacuated chamber (evacuated interior volume V2, column 2, l. 40)
through a liner of the x—ray tube formed from a thermally conductive material (front face of vacuum envelope I, column 9, ll. 1-3);
restraining the liner against deformation with a structural framework (rigid ribs K, column 9, ll. 3-8).

V1.2 D1 further discloses the subject matter of present **claim 20**:

An x-ray tube (title)
comprising:
a thermally conductive liner (front face of vacuum envelope I, column 9, ll. 1-3)
which spaces an evacuated chamber of the x-ray tube from a surrounding cooling fluid (figures 2, 4b);
a structural framework forming a cage which reinforces the liner against deformation (rigid ribs K, column 9, ll. 3-8).

V1.3 The subject-matter of present claim 1 is further not new in the sense of Article 33(2) PCT over the disclosure of D2.

The document **D2** discloses (the references in parentheses applying to this document):

An x-ray tube (title)
comprising:
a frame (vacuum enclosure 10 and shroud 35, figure 2, column 4, ll. 11-24)
which encloses an evacuated chamber (figure 2, column 4, ll. 11-24);
an anode (anode rotating anode assembly 12, figures 1 and 2; column 1, ll. 31-33, column 4, ll. 11-24)
disposed within the evacuated chamber (figure 2);
the frame including a vessel (vacuum enclosure 10)
which surrounds the anode (figure 2),
the vessel being defined by a combination of a material with high thermal conductivity and lower deformation resistance (vacuum enclosure 10 made of copper, column 4, ll. 25-27)
and a material with high deformation resistance and lower thermal conductivity (shroud 35 made of tungsten, column 4, ll. 29-31).

V2 The subject matter of present **dependent claims 2-17, 19, 21** is **also not new** with respect to the disclosure of D1 or D2:

claim 2:
An x-ray tube according to claim 1 (cf. items V1.1 and V1.3 above), wherein the vessel includes:
a liner formed from a thermally conductive material which at least partially defines the evacuated chamber (D1, front face I of the vacuum envelope made of titanium, figure 4b and column 9, ll. 1-3; D2, vacuum enclosure 10 made of copper, column 4, ll. 25-27);
and a framework which supports the liner and is formed from a structural material (D1, rigid ribs K made of stainless steel in figure 4b, column 9, ll. 3-8; D2, shroud 35 made of tungsten, column 4, ll. 29-31),
the framework defining at least one thermal window therein (D1, free standing foils I between each pair of ribs K, figure 4b; D2, figures 2 and 3, the space between the fins 34, column 4, ll. 20-23)
through which the liner is in thermal contact with both the evacuated chamber and a surrounding cooling fluid (D1, figures 2, 4b cooling fluid is air, column 7, ll. 9-13; D2, cooling fluid is again air, figures 2 and 3).

claim 3:
framework and liner concentric: D1, figure 4b; D2, figures 2,3

claim 4:
framework surrounds the liner: D2, figures 2, 3

claim 5:
thermal window comprises at least one slot: D1, the free standing foils I between each pair of ribs K in figure 4b form slots; D2, figures 2 and 3, the space between the fins 34 forms slots

claim 6:
angularly spaced slots: D2, figure 3

claims 7, 8:
the thermally conductive material has a thermal conductivity at least twice that of the structural material and the structural material has a yield strength which is at least twice that of the thermally conductive material: D2, copper has a thermal conductivity of 401W/mK and a yield strength of 54MPa, tungsten has a thermal conductivity of 173W/mK and a yield strength of 550MPa (cf. e.g. D3)

claim 9:
structural material includes stainless steel: D1, column 9, l. 8

claim 10:
thermally conductive material includes copper: D2, column 4, l. 27

claim 11:
liner includes a cylindrical side and a base and framework includes a cylindrical side and a base, the side of the liner being joined to the side of the framework: D2, figures 2, 3

claim 12:
one of the liner and the framework is received within the other: D1, figure 4b; D2,

figures 2, 3

claim 13:
the liner defines a central aperture and the framework defines a central aperture, the anode including a shaft which extends through the central apertures: D2, figures 1-3, column 3, ll. 28-37

claim 14:
the liner and the framework define a fluid flowpath there between for the cooling fluid to contact the liner: D2, figures 1-3, air flow through fins 34, column 4, ll. 41-47

claim 15:
plate which closes an end of the vessel, the plate defining an aperture through which a cathode assembly extends for emitting electrons that pass between a cathode and the anode: D2, protrusion 17 in figure 1

claim 16:
vessel comprises a laminate of the conductive and structural materials: D1, figure 4b

claim 17:
a housing surrounding at least a portion of the x-ray tube, the housing containing the cooling fluid: D2, figures 1-2, implicitly

claim 19:
the structural framework defines at least one thermal window, the heat flowing directly between the liner and the surrounding cooling fluid in the thermal window: cf. claim 2

claim 21:
anode mounted in the evacuated chamber: D1, figure 2

V3 **Remark:**
None of the available documents discloses an x-ray tube comprising a **combination of all the features of present claims 1, 2, 9 and 10** insofar as they can be

understood (cf. items VIII1 and VIII2 below).
Furthermore, a combination of D1 and D2 is not obvious to a skilled person but would be based on an ex-post-facto analysis.

Re Item VII
Certain defects in the international application

VII1 Independent claims 1, 18 and 20 are not drafted in the **two-part form** according to Rule 6.3 PCT.

VII2 **Reference sign (124)** in claims 2 and 19 refers not to thermal windows as indicated in the claims but to a cooling fluid outlet port (description, p. 13, l. 37)

Re Item VIII
Certain observations on the international application

VIII1 The **relative terms** "high" and "lower" used in **claim 1** have no well-recognised meaning and leave the reader in doubt as to the meaning of the technical features to which they refer, thereby rendering the definition of the subject-matter of said claim **unclear**, Article 6 PCT.
In particular, it is not clear from the wording of claim 1 whether the term "lower" with respect to deformation resistance / thermal conductivity of one material refers to the respective property of the other material (which would be a clear feature with respect to the term "lower" and the relation of the two materials) or just to a generally "lower" (thus "low") value of the respective property.

VIII2 The term **"deformation resistance"** in **claim 1 is unclear** as it does not relate to a particular, well-defined property of the material such as yield strength or the like.

VIII3 Although **claims 1 and 20** have been drafted as **separate independent apparatus claims**, they appear to relate effectively to the same subject-matter and to differ from each other only with regard to the definition of the subject-matter for which protection is sought and in respect of the terminology used for the features of that

subject-matter. The aforementioned claims therefore lack conciseness and as such do not meet the requirements of Article 6 PCT.